AD-A045 110 FLORIDA UNIV GAINESVILLE DEPT OF INDUSTRIAL AND SYS--ETC F/G 5/1
CONDENSED OPERATING MANUAL FOR NARF SAMPLING SYSTEM.(U)
AUG 77 R S LEAVENWORTH, Z LEKIC, H LORBERBAUM N00014-68-A-0173-0021
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RESEARCH REPORT

Industrial & Systems
Engineering Department
University of Florida
Gainesville, FL. 32611

(6)

CONDENSED OPERATING MANUAL FOR NARF SAMPLING SYSTEM.

(9) Research Report 77-8

by

(10) Richard S. Leavenworth,
Zoran Lekic
Henri Lorberbaum

(14) RR-77-8

(11) August 1977

(12) 31 p.

Department of Industrial and Systems Engineering
University of Florida
Gainesville, Florida 32611

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

(15)

This research was supported by the U. S. Department of the Navy, Office of Naval Research, under Contracts Number N00014-68-A-0173-0021 and N00014-75-C-0783.

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 77-8	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Condensed Operating Manual for NARF Sampling System		5. TYPE OF REPORT & PERIOD COVERED Technical 6. PERFORMING ORG. REPORT NUMBER 77-8
7. AUTHOR(s) Richard S. Leavenworth Zoran Lekic Henri Lorberbaum		8. CONTRACT OR GRANT NUMBER(s) N00014-68-A-0173-0021 N00014-75-C-0783
9. PERFORMING ORGANIZATION NAME AND ADDRESS Industrial & Systems Engineering University of Florida Gainesville, Florida 32611		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Process Control Sampling
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research 800 N. Quincy Arlington, VA 22217		12. REPORT DATE August, 1977 13. NUMBER OF PAGES 40
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

N/A

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Process Control
Random Sampling
AOQL

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report contains an abbreviated set of plans and procedures from "Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling," (Research Report 76-4, Department of Industrial and Systems Engineering, University of Florida, Gainesville, Florida 32611). It is intended as a "shop floor" operating manual for quality assurance inspection personnel, and contains those plans and procedures most used by the Naval Air Rework Facility, Jacksonville, Florida. Procedures have been abbreviated

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20.

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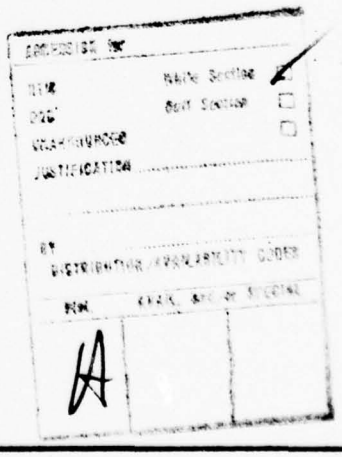

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Abstract

This report contains an abbreviated set of plans and procedures from "Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling" (Research Report 76-4, Department of Industrial and Systems Engineering, University of Florida, Gainesville, Florida 32611). It is intended as a "shop floor" operating manual for quality assurance inspection personnel and contains those plans and procedures most used by the Naval Air Rework Facility, Jacksonville, Florida. Procedures have been abbreviated from the above mentioned source document. This report is intended to supplement the source document, not to replace it.

1. INTRODUCTION

This document contains a condensed version of the instructions for operating the sampling system contained in Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling (hereafter referred to as the "Procedure Manual." [Ref. 1]). These instructions are essentially those contained in Section 2, of the Procedure Manual titled "Determining a Sampling System," and Section 3, titled "Operating the Sampling System."

The Composite Tables on pages 17 through 35 have been organized from Tables I, II, and III of the Procedure Manual for selected values of AQL. They are not intended to be complete or exhaustive.

Definitions, discussions, and operating characteristics have been specifically omitted in order to provide the user with a quick reference guide. The user will need to become familiar with all aspects of the Procedure Manual in order to become proficient at using the sampling system.

MONTHLY VERIFICATION REPORT

INSPECTION LEVEL [II] AQL [1.5] AOQL [2.5] LQ [9.0]

Shop No. 9XXXX

QA Specialist JONES

Period 2-15-76 To 3-12-76

	UNITS	MH EXPENDED
Wk 1	66	351.24
Wk 2	28	141.80
Wk 3	25	93.76
Wk 4	98	195.26
TOTAL	217	782.06
Avg.	54.2	195.5
Prod. Interval		250

AVERAGE UNITS/MH [0.28]

	SAMPLE HOURS	SAMPLE SIZE	CONTROL LIMIT
r	12.5	4	12.0
n	31.4	9	8.0
t	49.8	14	5.0

ADDITIONAL ACTIVITIES	

Sample Hrs.	Wk	1	2	3	4	Total
Required						
Completed						
% Completed						

[O] Sample verified, no defects

[X] Sample verified, 1 or more defects

[ ] Sample skipped

[M] Mandatory inspection

(OVER)

Sampling Level (R,N,T,M)	S	M	T	W	T	F	S

SAMPLING SEQUENCE

No.	CERTIFIER	No.	CERTIFIER	No.	CERTIFIER	No.	CERTIFIER
1		24		47		70	
2		25		48		71	
3		26		49		72	
4		27		50		73	
5		28		51		74	
6		29		52		75	
7		30		53		76	
8		31		54		77	
9		32		55		78	
10		33		56		79	
11		34		57		80	
12		35		58		81	
13		36		59		82	
14		37		60		83	
15		38		61		84	
16		39		62		85	
17		40		63		86	
18		41		64		87	
19		42		65		88	
20		43		66		89	
21		44		67		90	
22		45		68		91	
23		46		69		92	

REMARKS

(OVER)

MANDATORY B&C - SPECIAL STUDIES

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2

2. OPERATING THE SAMPLING SYSTEM

2.1 Instructions for Completing the Monthly Verification Report (MVR)

(1) Enter the following data in the upper right hand corner:

(a) Shop number.

(b) QA Specialist's name.

(c) Recording period.

(2) Enter the following data in the upper left hand corner:

(a) Designated inspection level.

(b) Designated AQL.

(3) To Determine Production Interval:

(a) Remove duplicate link numbers from "Weekly Completion Reports."

(b) Insert grand totals of units and man-hours expended in WK1, WK2, WK3, and WK4 boxes.

(c) Total the column of units and man-hours expended.

(d) Determine the average of units and man-hours expended.

(e) Convert the average of man-hours expended to the nearest whole number. This value is normally used as the Production Interval.

(4) To Determine the Sample Size:

(a) Calculate the average units per man-hour by dividing the total units produced by the total man-hours expended. Enter this figure in the Average Units/MH box.

(b) Go to the composite tables (pages 17 - 35) for the designated Inspection Level and AQL. For the appropriate Production Interval:

(i) Find the sample hours for Reduced, Normal, and Tightened inspection and enter these values in H_r, H_n, and H_t, respectively.

(ii) Find the control limits for Reduced, Normal, and Tightened inspection and enter these values in CL_r, CL_n, and CL_t, respectively.

(iii) Enter the value for the Limiting Quality (LQ) in the LQ box.

(iv) Find the AOQL value from the top of the table and enter the value in the AOQL box.

(c) Multiply the value of Average Units/MH times the Sample Hours H_r, H_n, and H_t, to obtain the sample sizes N_r, N_n, and N_t, respectively. If the value for the sample size is 5 or less, round off to the next higher digit; otherwise round off to the nearest digit.

(5) Determine the order of sampling:

(a) Prepare a list of certifiers (and "sole artisans") to be sampled, including apprentices as appropriate, and number this list in sequence

MONTHLY VERIFICATION REPORT

INSPECTION LEVEL: II | AQL: 1.5 | AOQL: 2.5 | LQ: 9.0 | Shop No.: 9XXXX

AVERAGE UNITS/MH: 0.28 | QA Specialist: JONES | Period: 2/15/76 To 3/12/76

	UNITS	MH EXPENDED
Wk 1	66	351.24
Wk 2	28	141.80
Wk 3	25	93.76
Wk 4	98	195.26
TOTAL	217	782.06
Avg.	54.2	195.5
Prod. Interval	2.50	

SAMPLE HOURS		SAMPLE SIZE		CONTROL LIMIT	
H_r	12.5	N_r	4	CL_r	12.0
H_n	31.4	N_n	9	CL_n	8.0
H_t	49.8	N_t	14	CL_t	5.0

ADDITIONAL ACTIVITIES	
CALIBRATION AUDIT	1

Sample Hrs.	Wk 1	2	3	4	Total
Required	31.4	31.4	22.0	49.8	332.6
Completed	32.4	36.2	23.4	53.3	355.9
% Completed	103	115	106	107	107

[ ] (OVER)

[0] Sample verified, no defects

[X] Sample verified, 1 or more defects

[ ] Sample skipped

[M] Mandatory inspection

Sampling Level (R,N,T,M)

	S	M	T	W	T	F	S
N	15	2	5	7	9	10	
N	22	13	14	15	16	18	
M	29	19 20	21	22	23	24	25
K	7	27	29	31	32	34	

REMARKS

(OVER)

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SAMPLING SEQUENCE

No.	CERTIFIER		No.	CERTIFIER		No.	CERTIFIER	No.	CERTIFIER
1	A1467		24	A1431	(M)	47		70	
2	A1514	0	25	A1467	X	48		71	
3	A1514		26	A2423		49		72	
4	A1431		27	A1444	X	50		73	
5	A447	X	28	A405		51		74	
6	A1469		29	A1469	0	52		75	
7	A1444	0	30	A282		53		76	
8	A2633		31	A1431	0	54		77	
9	A1467	X	32	A1514	X	55		78	
10	A405	0	33	A1431		56		79	
11	A2633		34	A1444	0	57		80	
12	A447		35	A405		58		81	
13	A1469	X	36	A1467		59		82	
14	A1431	0	37	A2423		60		83	
15	A282	X	38			61		84	
16	A2423	0	39			62		85	
17	A405		40			63		86	
18	A282		41			64		87	
19	A405	X	42			65		88	
20	A2423	X	43			66		89	
21	A282	(M)	44			67		90	
22	A405	X	45			68		91	
23	A1469	(M)	46			69		92	

MANDATORY B&C - SPECIAL STUDIES

beginning with one (1).

(b) Drop a pencil over the Table of Random Numbers (page 37). The point of the pencil marks the starting place.

(c) Reading in one of the directions (right, left, up, or down) match the numbers from the Table of Random Numbers with the sequence number of certifiers.

(d) Enter the certifier's stamp number in the boxes provided on the MVR according to the sequence of selection from the Table of Random Numbers.

(e) Certifiers are now listed on the MVR in the preferred sequence in which verification should be performed. However, Verifier's time should not be wasted; a certifier may be passed over temporarily.

(f) Record verification action and findings in the box to the right of certifier's number.

(6) Symbols to be used in recording verifications are listed on the MVR.

(7) List the row number for the certifier verified on the calendar area of the MVR whenever a verification is performed.

(8) Record significant actions taken, such as shifts in levels of sampling or special problems encountered, in the "Remarks" area of MVR. If the reverse side of the form is used to extend remarks, place an "X" in the "over" box in Remarks area.

(9) Record the following information in the "Additional Activities" box:

(a) Based on the appropriate sampling level, enter the value for the sample hours (H_r, H_n, or H_t) in the columns marked Wk/1, 2, 3, and 4.

(b) From the Shop Verification Control Chart Summary Form (page 10), obtain the values of the "$\sum$MH" column for each Production Interval and enter these values in the row labeled "Completed."

(c) To obtain the "% Completed," divide the sample hours completed by the sample hours required and multiply by 100.

(d) Total the weekly values in the "Required" row and in the "Completed" row and enter these values in the column labeled "Total."

(e) To obtain the "% Completed" for the total, divide the total completed hours by the total required hours and multiply by 100.

(10) Report leave time in the calendar area. Other significant comments or remarks may be entered in the calendar area or in the remarks area.

(11) Record in the designated spaces any additional activities performed. If more space is required, enter on back of MVR and place an "X" in the "over" box at the bottom of the "Additional Activities" area.

MONTHLY VERIFICATION REPORT

INSPECTION LEVEL [II] AQL [1.5] AOQL [2.5] LQ [9.0] Shop No. 9XXXX

QA Specialist JONES

Period 2/15/76 To 3/12/76

	UNITS	MH EXPENDED
Wk 1	66	351.24
Wk 2	28	141.80
Wk 3	25	93.76
Wk 4	98	195.26
TOTAL	217	782.06
Avg.	54.2	195.5
Prod. Interval		250

AVERAGE UNITS/MH [0.28]

SAMPLE HOURS		SAMPLE SIZE		CONTROL LIMIT	
H_r	12.5	N_r	41	CL_r	12.0
H_n	31.4	N_n	9	CL_n	8.0
H_t	49.8	N_t	14	CL_t	5.0

ADDITIONAL ACTIVITIES	
CALIBRATION AUDIT	1

Sample Hrs.	Wk	1	2	3	4	Total
Required		31.4	31.4	220	49.8	232.6
Completed		32.4	36.2	234	53.3	355.9
% Completed		103	115	106	107	107

[O] Sample verified, no defects

[X] Sample verified, 1 or more defects

[ ] Sample skipped

[M] Mandatory inspection

(OVER)

Sampling Level (R,N,T,M)

	S	M	T	W	T	F	S
N	15	2	5	7	9	10	
N	22	13	14	15	16	18 TO M-A	
M	29	19 20	21	22	23	24	25 CLEAR TO T
T	7	27	29	31	32	34	

REMARKS #AØ REMAINS ON MANDATORY C. CLEARED 2/24
WIDGET ON MANDATORY B.
TO MANDATORY A 2/28. GENERAL SHOP PROBLEM.
FOREMAN ACTION. CLEARED TO T ON 3/6 (OVER)

RSL 5-77

SAMPLING SEQUENCE

No.	CERTIFIER		No.	CERTIFIER		No.	CERTIFIER		No.	CERTIFIER	
1	A1467		24	A1431	(M)	47			70		
2	A1514	O	25	A1467	X	48			71		
3	A1514		26	A2423		49			72		
4	A1431		27	A1444	X	50			73		
5	A447	X	28	AØ5		51			74		
6	A1469		29	A1469	O	52			75		
7	A1444	O	30	A282		53			76		
8	A2633		31	A1431	O	54			77		
9	A1467	X	32	A1514	X	55			78		
10	A405	O	33	A1431		56			79		
11	A2633		34	A1444	O	57			80		
12	A447		35	AØ5		58			81		
13	A1469	X	36	A1467		59			82		
14	A1431	O	37	A2423		60			83		
15	A282	X	38			61			84		
16	A2423	O	39			62			85		
17	AØ5		40			63			86		
18	A282	X	41			64			87		
19	AØ5	(M)	42			65			88		
20	A2423	(M)	43			66			89		
21	A282	(M)	44			67			90		
22	AØ5	(M)	45			68			91		
23	A1469	(M)	46			69			92		

MANDATORY B&C - SPECIAL STUDIES

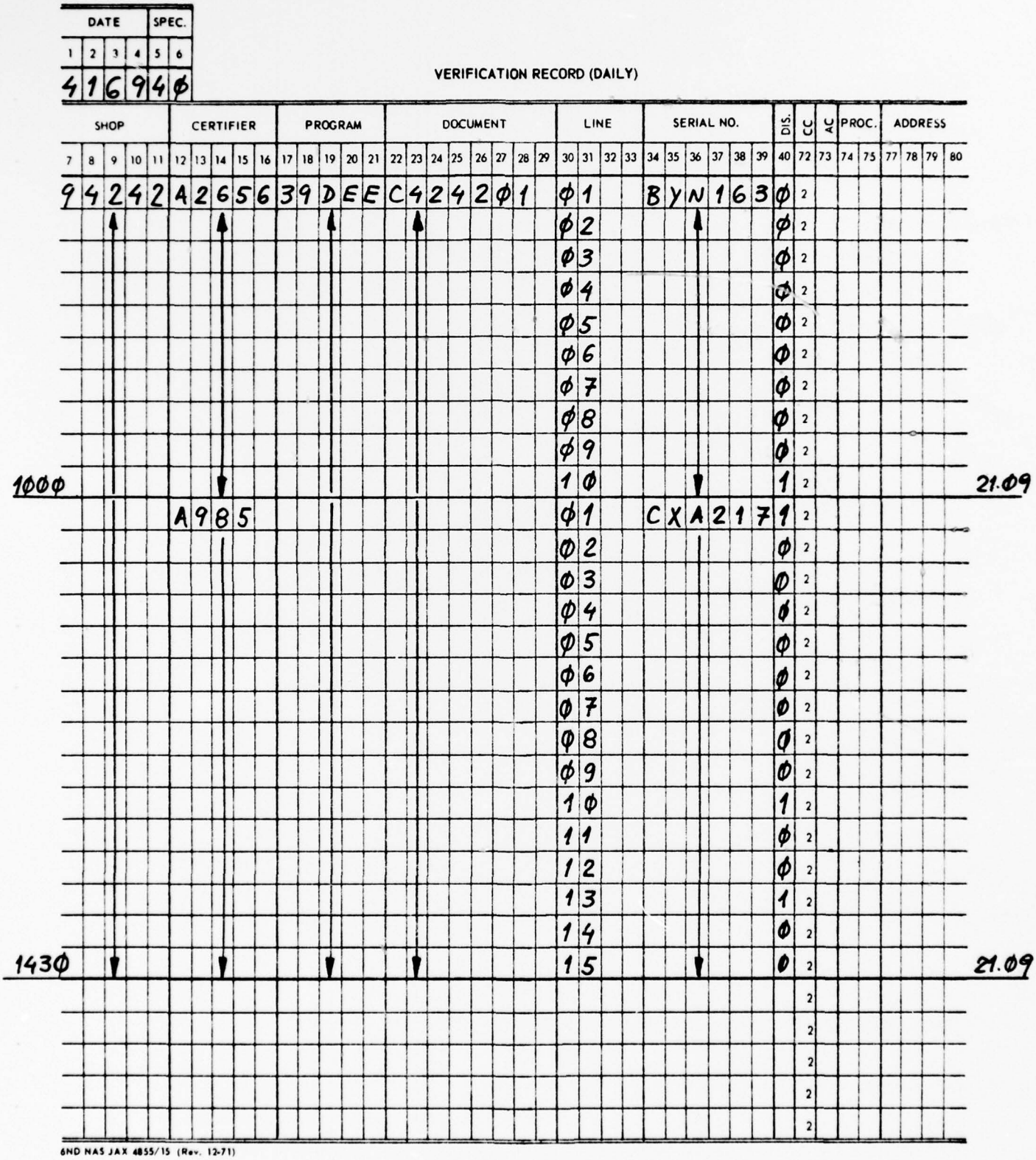
AØ	(M)		(M)																					
WIDGET	(M)	(M)		(M)	(M)	(M)																		

(12) Indicate Mandatory A inspection in the calendar and "Remarks" areas.

(13) Mandatory B and Mandatory C inspections are to be recorded in the table in lower right corner. Data from Mandatory B and C inspection is kept separated from the sample data and is not used for control charting.

2.1.2 Instructions for "Sole Person" Shops

For those shops in which only one artisan works consult Procedure Manual, Section 3.1.2, Page 20a, for special instructions.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CERTIFIER
PROGRAM
DOCUMENT
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SERIAL NO.
DIS.
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AC
PROC.
ADDRESS
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9 4 2 4 2 A 2 6 5 6 3 9 D E E C 4 2 4 2 ϕ 1 ϕ 1 B Y N 1 6 3 ϕ 2
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2.2 Instructions for Completing the Daily Verification Record (DVR)

(1) The DVR is prepared in accordance with QRAINST 4855.21G with the following additions and exceptions:

(a) A separate DVR form is to be prepared for each shop.

(b) All characteristics from the QCL which are the responsibility of the certifier being checked are to be verified at that stage of rework.

(c) After the completion of the verification of characteristics on the component, extend the line beneath the last characteristic to the right margin of the DVR form.

(d) On the right margin of the form and directly above the extended line, write in the standard hours required to perform the rework as listed on the work order accompanying the component. If the standard hours are not listed, an estimate must be obtained from the production supervisor or taken from a previous "Weekly Completion Report."

(e) The total number of defects found on the item, and attributable to the certifier being verified, is entered on the right hand side of the DVR above the standard hours and circled.

(f) Total the defects found and standard man-hours for the day and enter in the appropriate area of the Shop Verification Control Chart (SVCC) Data Summary Form (page 10).

(g) Defects found on a product unit attributable to another certifier or another shop are to be recorded separately from the sample data. (See Procedure Manual, Section 3.5, page 32).

(h) All other instructions contained in QRAINST 4855.21G and pertaining to completing DVR's remain in force.

SHOP VERIFICATION CONTROL CHART

DATA SUMMARY

AQL - 1.5 QA SPECIALIST Jones SHOP NO. 9XXXX

	Date	Defects	Man-Hours	Σd	ΣMH
R, N, T, M R H 12.5 N 4	2-2-76	0	6.5	0	6.5
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{1}{.163}$	2-3-76	1	9.8	1	16.3
U = 6.13					
CL = 12. (Table II)					
R, N, T, M R H 12.5 N 4	2-9-76	0	2.6	0	2.6
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{1}{.156}$	2-10-76	1	5.1	1	7.7
	2-11-76	0	3.6	1	11.3
U = 6.41	2-13-76	0	4.3	1	15.6
CL = 12. (Table II)					
R, N, T, M N H 31.4 N 9	2-16	0	5.6	0	5.6
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{2}{.324}$	2-17	1	7.5	1	13.1
	2-18	0	3.4	1	16.5
U = 6.17	2-19	1	8.6	2	25.1
CL = 8. (Table II)	2-20	0	7.3	2	32.4
R, N, T, M N H 31.4 N 9	2-23	1	7.4	1	7.4
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{3}{.362}$	2-24	0	8.3	1	15.7
	2-25	1	3.4	2	19.1
U = 8.28	2-26	0	5.7	2	24.8
CL = 8. (Table II)	2-27	1	11.4	3	36.2
R, N, T, M M H 31.4 N 9	3-1	1	32.9	1	32.9
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{1}{.329}$					
U = 3.03					
CL = 8. (Table II)					
R, N, T, M M H 31.4 N 9	3-1	3	32.4	3	32.4
$U = \frac{\Sigma d}{\Sigma MH/100} = \frac{3}{.324}$					
U = 9.25					
CL = 8. (Table II)					

RSL . 10-75

2.3 Instructions for Completing the Shop Verification Control Chart (SVCC) Data Summary Form

(1) Enter the following data at the top of the form:
   (a) Designated AQL.
   (b) QA Specialist's name.
   (c) Shop number.

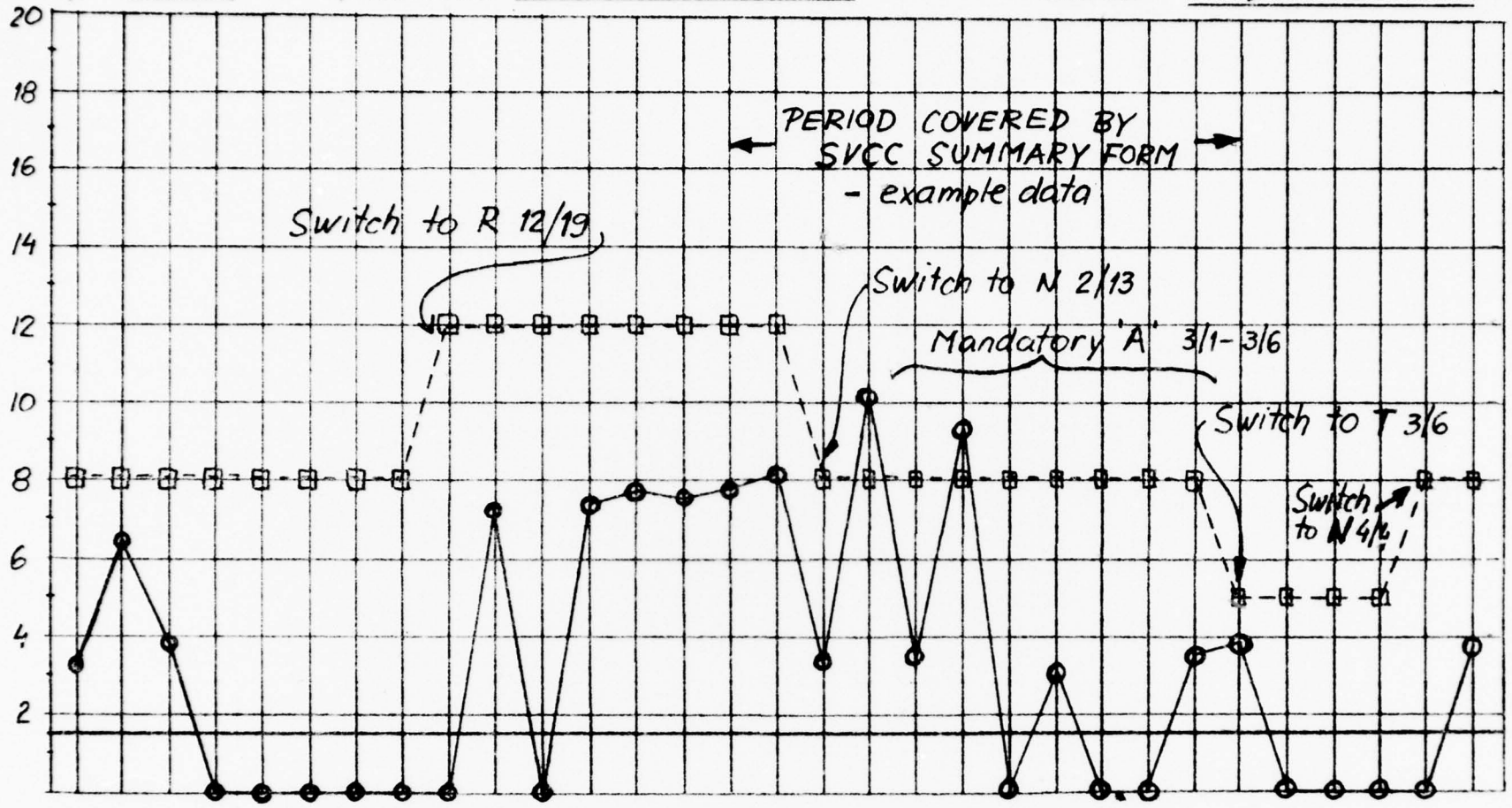
(2) From the DVR, record each day's data for a shop for a normal production interval in one block. When Mandatory A inspection is in force, the data for one subgroup should be entered in a block. This may be less than one day's record (Mandatory B and C inspection is not used for control charting).
   (a) Indicate in the block the sampling level (R, N, T, or M).
   (b) Enter the value of the sample hours (H_r, H_n, or H_t) in the "H" space and the expected number of items to be inspected (N_r, N_n, or N_t) in the "N" space.
   (c) From the shop DVR, enter the date, number of defects found, and total man-hours in the appropriate block of the Data Summary form.
   (d) Add together the daily defects found and enter in the "$\sum$d" column.
   (e) Add together the daily man-hours of inspection and enter in the "$\sum$MH" column.
   (f) As soon as the value in the "$\sum$MH" column equals or exceeds the value in the "H" box, verification inspection for that Production Interval (or subgroup) is terminated.

(3) The value of U (defects per 100 man-hours) for the Production Interval is determined by dividing "$\sum$d" by "$\sum$MH/100" ($\sum$MH divided by 100).

(4) The value of the appropriate control limit (CL) is entered from the MVR (CL_r, CL_n, or CL_t).

SHOP VERIFICATION CONTROL CHART

AQL = 1.5 QA SPECIALIST JONES SHOP NO. 9XXXX



DEFECTS PER 100 MAN-HOURS (U)

DATE	11-1	11-8	11-15	11-22	11-29	12-5	12-12	12-19	12-26	1-2	1-9	1-16	1-23	1-30	2-6	2-13	2-20	2-27	3-1	3-1	3-2	3-3	3-4	3-5	3-6	3-12	3-19	3-26	4-2	4-9	4-16
U	3.25	6.37	3.95	0	0	0	0	0	0	7.18	0	7.38	7.75	7.64	7.89	8.05	3.37	10.07	3.54	9.32	0	2.97	0	0	3.62	3.89	0	0	0	0	3.94
CL	8	8	8	8	8	8	8	8	12	12	12	12	12	12	12	12	8	8	8	8	8	8	8	8	8	5	5	5	5	8	8

RSL. 10-75

2.4 Instructions for Completing the Shop Verification Control Chart (SVCC)

(1) Enter the following data at the top of the chart:

(a) Designated AQL.

(b) QA Specialist's name.

(c) Shop number.

(2) Draw the AQL as a solid line across the face of the chart.

(3) From the SVCC Data Summary form, enter the following data at the bottom of the chart:

(a) Date of entry for the Production Interval.

(b) The Value of U.

(c) The Value of CL, (Control Limit).

(4) On the vertical line directly above the data are plotted the values of U and CL. The latest value of U is connected to the previous value by a solid line. The latest value of the CL is connected to the previous value by a dashed line.

(5) Switching rules described below are applied to determine the level of sampling (or Mandatory inspection) required during the next Production Interval.

(a) Normal to Tightened: A shift from Normal (H_n) to Tightened (H_t) sampling is required if 7 consecutive points on the SVCC fall above the AQL while on Normal sampling.

(b) Tightened to Normal: A shift from Tightened (H_t) to Normal (H_n) sampling is allowed if 3 consecutive points on the SVCC fall below the AQL while on Tightened sampling.

(c) Normal to Reduced: A shift from Normal (H_n) to Reduced (H_r) sampling is allowed if 5 consecutive points on the SVCC fall below the AQL while on Normal sampling.

(d) Reduced to Normal: A shift from Reduced (H_r) to Normal (H_n) sampling is required if 5 consecutive points on the SVCC fall above the AQL while on Reduced sampling.

(e) Normal, Reduced, or Tightened to Mandatory: A point above the control limit (CL_r, CL_n, or CL_t) on the SVCC requires an immediate shift to Mandatory inspection.

(f) Whenever a switch to Mandatory inspection occurs, consult Procedure Manual, Sections 2.7.7 through 2.7.9, pages 14 - 16, for instructions. Figure 1 (page 15) shows a flow chart of these switching rules.

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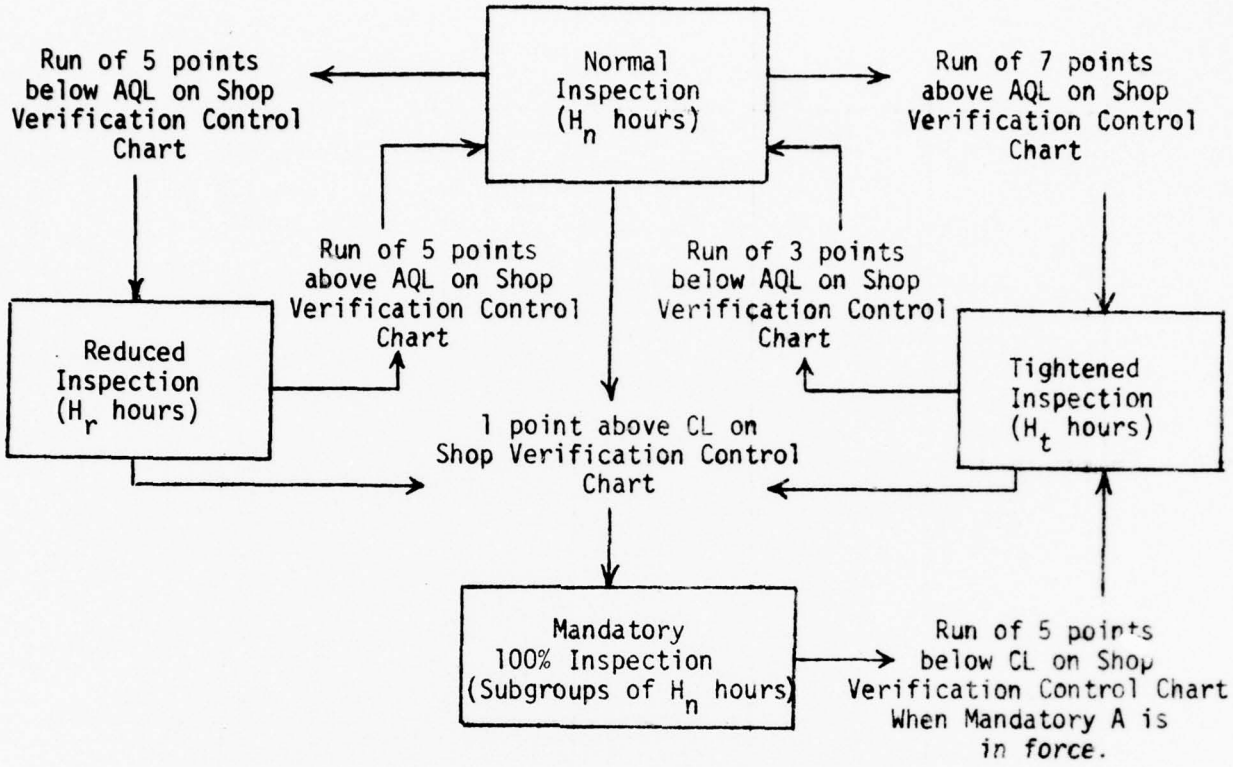

Figure 1. Flow Chart of Sampling System

References

[1] "Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling," Richard S. Leavenworth, Richard L. Scheaffer, and Charles J. Lyon, Research Report No. 76-4, Department of Industrial and Systems Engineering, University of Florida, February 1976.

[2] "Procedure for Maintenance and Rework Process Quality Control Based on Random Sampling," Richard S. Leavenworth, Richard L. Scheaffer, and Charles J. Lyon, Research Report No. 76-5, Department of Industrial and Systems Engineering, University of Florida, February 1976.

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COMPOSITE TABLE

Inspection level = I

AQL in defects per 100 man-hours = 1.0

AOQL = 2.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL I

AQL 1.0

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced			
	normal			
	tightened			
316-500	reduced			
	normal			
	tightened	↓	↓	↓
501-800	reduced	12.2	4.0	7.3
	normal	30.5	5.0	
	tightened	48.4	5.0	
801-1250	reduced	14.0	3.5	6.5
	normal	35.3	4.0	
	tightened	55.9	4.5	
1251-2000	reduced	15.8	9.5	6.0
	normal	39.8	4.0	
	tightened	63.0	4.0	
2001-3160	reduced	25.3	6.0	5.5
	normal	63.5	4.0	
	tightened	101	3.5	
3161-5000	reduced	27.8	5.5	5.3
	normal	69.9	3.5	
	tightened	111	3.0	
5001-8000	reduced	39.3	4.0	4.9
	normal	98.6	3.5	
	tightened	156	3.0	
over 8000	reduced	42.3	3.5	4.7
	normal	106	3.5	
	tightened	169	2.5	

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COMPOSITE TABLE

Inspection level = I

AQL in defects per 100 man-hours = 1.5

AOQL = 4.0

↓ Proceed in direction of arrow until first plan is encountered

LEVEL I

AQL 1.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced			
	normal			
	tightened			
316-500	reduced	7.7	6.5	11.5
	normal	19.3	7.5	
	tightened	30.5	8.0	
501-800	reduced	8.9	5.5	10.4
	normal	22.2	6.5	
	tightened	35.3	7.0	
801-1250	reduced	10.0	15.0	9.6
	normal	25.1	6.0	
	tightened	39.8	6.0	
1251-2000	reduced	16.0	9.5	8.8
	normal	40.1	6.0	
	tightened	63.5	5.5	
2001-3160	reduced	17.6	8.5	8.4
	normal	44.1	5.5	
	tightened	69.9	5.0	
3161-5000	reduced	24.8	6.0	7.8
	normal	62.2	5.5	
	tightened	98.6	4.5	
5001-8000	reduced	26.7	5.5	7.4
	normal	67.1	5.0	
	tightened	106	4.0	
over 8000	reduced	35.0	7.0	7.0
	normal	88.0	5.0	
	tightened	140	4.0	

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COMPOSITE TABLE

Inspection level = I

AQL in defects per 100 man-hours = 2.5

AOQL = 6.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL I

AQL 2.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced	4.8	10.5	18.3
	normal	12.2	12.5	
	tightened	19.3	13.0	
316-500	reduced	5.6	9.0	16.4
	normal	14.0	10.5	
	tightened	22.2	11.0	
501-800	reduced	6.3	24.0	15.1
	normal	15.8	9.5	
	tightened	25.1	10.0	
801-1250	reduced	10.1	15.0	13.9
	normal	25.3	10.0	
	tightened	40.1	8.5	
1251-2000	reduced	11.1	13.5	13.3
	normal	27.8	9.0	
	tightened	44.1	8.0	
2001-3160	reduced	15.6	10.0	12.3
	normal	39.3	9.0	
	tightened	62.2	7.0	
3161-5000	reduced	16.9	9.0	11.8
	normal	42.3	8.0	
	tightened	67.1	6.5	
5001-8000	reduced	22.1	11.0	11.1
	normal	55.5	8.0	
	tightened	88.0	6.0	
over 8000	reduced	24.2	10.0	10.5
	normal	60.7	7.5	
	tightened	96.2	6.5	

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COMPOSITE TABLE

Inspection level = I

AQL in defects per 100 man-hours = 10.0

AOQL = 25.0

↓ Proceed in direction of arrow until first plan is encountered

LEVEL I

AQL 10.0

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	1.4	36.0	65.3
	normal	3.5	43.0	
	tightened	5.6	45.0	
126-200	reduced	1.6	94.0	60.3
	normal	4.0	38.0	
	tightened	6.3	40.0	
201-315	reduced	2.5	60.0	55.3
	normal	6.4	39.0	
	tightened	10.1	35.0	
316-500	reduced	2.8	54.0	52.7
	normal	7.0	36.0	
	tightened	11.1	32.0	
501-800	reduced	3.9	38.0	49.1
	normal	9.9	35.0	
	tightened	15.6	29.0	
801-1250	reduced	4.2	36.0	47.0
	normal	10.6	33.0	
	tightened	16.9	27.0	
1251-2000	reduced	5.6	45.0	44.2
	normal	14.0	32.0	
	tightened	22.1	25.0	
2001-3160	reduced	6.1	40.0	41.8
	normal	15.3	29.0	
	tightened	24.2	27.0	
3161-5000	reduced	6.4	39.0	40.7
	normal	16.1	28.0	
	tightened	25.5	26.0	
5001-8000	reduced	7.9	32.0	39.3
	normal	19.9	28.0	
	tightened	31.5	24.0	
over 8000	reduced	8.3	42.0	38.4
	normal	20.8	26.0	
	tightened	32.9	23.0	

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COMPOSITE TABLE

Inspection level = II

AQL in defects per 100 man-hours = 1.0

AOQL = 1.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL II

AQL 1.0

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced			
	normal			
	tightened			
316-500	reduced	19.8	7.5	5.7
	normal	49.8	5.0	
	tightened	79.0	3.0	
501-800	reduced	26.2	5.5	4.5
	normal	65.9	4.0	
	tightened	104	3.5	
801-1250	reduced	29.9	5.0	4.2
	normal	75.1	3.5	
	tightened	119	3.0	
1251-2000	reduced	42.9	3.5	3.9
	normal	108	3.5	
	tightened	171	2.5	
2001-3160	reduced	62.1	4.0	3.4
	normal	156	3.0	
	tightened	247	2.5	
3161-5000	reduced	79.5	3.0	3.2
	normal	200	2.8	
	tightened	317	2.4	
5001-8000	reduced	99.0	3.5	3.1
	normal	249	2.5	
	tightened	394	2.2	
over 8000	reduced	112	3.2	2.8
	normal	280	2.4	
	tightened	444	2.2	

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COMPOSITE TABLE

Inspection level = II

AQL in defects per 100 man-hours = 1.5

AOQL = 2.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL II

AQL 1.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced	12.5	12.0	9.0
	normal	31.4	8.0	
	tightened	49.8	5.0	
316-500	reduced	16.6	9.0	7.2
	normal	41.6	6.0	
	tightened	65.9	5.5	
501-800	reduced	18.9	8.0	6.6
	normal	47.4	5.5	
	tightened	75.1	4.5	
801-1250	reduced	27.1	5.5	6.2
	normal	68.0	5.0	
	tightened	108	4.0	
1251-2000	reduced	39.2	6.5	5.4
	normal	98.4	4.5	
	tightened	156	4.0	
2001-3160	reduced	50.2	5.0	5.1
	normal	126	4.5	
	tightened	200	3.8	
3161-5000	reduced	62.4	5.5	4.9
	normal	157	4.0	
	tightened	249	3.5	
5001-8000	reduced	70.4	5.0	4.5
	normal	177	3.6	
	tightened	280	3.4	
over 8000	reduced	93.4	4.5	4.3
	normal	235	3.5	
	tightened	372	3.1	

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COMPOSITE TABLE

Inspection level = II

AQL in defects per 100 man-hours = 2.5

AOQL = 4.0

↓ Proceed in direction of arrow until first plan is encountered

LEVEL II

AQL 2.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced	7.9	19.0	14.3
	normal	19.8	12.5	
	tightened	31.4	8.0	
201-315	reduced	10.4	14.5	11.4
	normal	26.2	9.5	
	tightened	41.6	8.5	
316-500	reduced	11.9	12.5	10.4
	normal	29.9	8.5	
	tightened	47.4	7.5	
501-800	reduced	17.1	8.5	9.8
	normal	42.9	8.0	
	tightened	68.0	6.5	
801-1250	reduced	24.7	10.0	8.6
	normal	62.1	7.0	
	tightened	98.4	6.5	
1251-2000	reduced	31.7	8.0	8.2
	normal	79.5	7.0	
	tightened	126	6.0	
2001-3160	reduced	39.4	9.0	7.7
	normal	99.0	6.5	
	tightened	157	5.5	
3161-5000	reduced	44.4	8.0	7.1
	normal	112	5.8	
	tightened	177	5.4	
5001-8000	reduced	58.9	7.5	6.8
	normal	148	5.8	
	tightened	235	5.0	
over 8000	reduced	76.5	7.0	6.5
	normal	192	5.5	
	tightened	305	4.8	

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COMPOSITE TABLE

Inspection level = III

AQL in defects per 100 man-hours = 1.0

AOQL = 1.0

↓ Proceed in direction of arrow until first plan is encountered

LEVEL III

AQL 1.0

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced			
	normal			
	tightened			
201-315	reduced	24.4	6.0	4.3
	normal	61.4	4.0	
	tightened	97.3	3.6	
316-500	reduced	36.5	4.0	4.0
	normal	91.7	3.8	
	tightened	145	3.0	
501-800	reduced	48.5	5.2	3.3
	normal	122	2.9	
	tightened	193	2.9	
801-1250	reduced	66.9	3.8	3.0
	normal	168	2.7	
	tightened	266	2.4	
1251-2000	reduced	98.8	3.5	2.8
	normal	248	2.6	
	tightened	394	2.2	
2001-3160	reduced	144	3.0	2.5
	normal	362	2.4	
	tightened	574	2.0	
3161-5000	reduced	198	2.8	2.2
	normal	498	2.1	
	tightened	789	1.8	
5001-8000	reduced	274	2.4	2.1
	normal	689	2.0	
	tightened	1,093	1.7	
over 8000	reduced	387	2.2	1.9
	normal	972	1.8	
	tightened	1,540	1.65	

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COMPOSITE TABLE

Inspection level = III

AQL in defects per 100 man-hours = 1.5

AOQL = 1.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL III

AQL 1.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	↓	↓	↓
	normal			
	tightened			
126-200	reduced	15.4	10.0	6.8
	normal	38.7	6.5	
	tightened	61.4	5.5	
201-315	reduced	23.0	6.5	6.4
	normal	57.9	6.0	
	tightened	91.7	5.0	
316-500	reduced	30.6	8.0	5.2
	normal	76.8	4.6	
	tightened	122	4.5	
501-800	reduced	42.2	6.0	4.8
	normal	106	4.2	
	tightened	168	3.8	
801-1250	reduced	62.4	5.6	4.4
	normal	157	4.0	
	tightened	248	3.4	
1251-2000	reduced	91.0	5.0	3.9
	normal	229	3.8	
	tightened	362	3.2	
2001-3160	reduced	125	4.4	3.5
	normal	314	3.3	
	tightened	498	2.9	
3161-5000	reduced	173	3.8	3.3
	normal	435	3.1	
	tightened	689	2.7	
5001-8000	reduced	244	3.5	3.0
	normal	613	2.8	
	tightened	972	2.6	
over 8000	reduced	331	3.2	2.7
	normal	831	2.6	
	tightened	1,317	2.4	

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COMPOSITE TABLE

Inspection level = III

AQL in defects per 100 man-hours = 2.5

AOQL = 2.5

↓ Proceed in direction of arrow until first plan is encountered

LEVEL III

AQL 2.5

SHOPS:

Production Interval in Average Man-Hours	Sampling level	Sample hours in man-hours of production (H)	Control Limits (CL)	Limiting Quality (LQ)
0-125	reduced	9.7	16.0	10.7
	normal	24.4	10.0	
	tightened	38.7	9.0	
126-200	reduced	14.5	10.0	10.1
	normal	36.5	10.0	
	tightened	57.9	7.5	
201-315	reduced	19.3	13.0	8.2
	normal	48.5	7.0	
	tightened	76.8	7.0	
316-500	reduced	26.6	9.0	7.6
	normal	66.9	6.8	
	tightened	106	6.0	
501-800	reduced	39.3	9.0	6.9
	normal	98.8	6.6	
	tightened	157	5.4	
801-1250	reduced	57.4	7.8	6.2
	normal	144	5.9	
	tightened	229	5.0	
1251-2000	reduced	78.9	7.0	5.6
	normal	198	5.3	
	tightened	314	4.6	
2001-3160	reduced	109	6.0	5.2
	normal	274	5.0	
	tightened	435	4.3	
3161-5000	reduced	154	5.5	4.8
	normal	387	4.5	
	tightened	613	4.2	
5001-8000	reduced	209	5.0	4.3
	normal	524	4.1	
	tightened	831	3.8	
over 8000	reduced	291	4.6	4.1
	normal	731	4.0	
	tightened	1,159	3.6	

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Table of Random Numbers
(1 - 50)

43	37	23	33	49	10	11	44	6	39
8	4	15	3	31	29	19	20	16	24
22	38	50	7	32	1	18	47	12	35
17	5	41	42	21	26	48	2	13	28
30	45	27	14	25	46	36	40	34	9
42	33	6	35	8	2	10	30	21	44
15	39	22	38	25	40	3	23	7	4
31	16	13	34	27	41	9	14	24	19
37	48	43	47	11	45	36	12	1	46
50	28	26	20	32	29	5	18	49	17
2	7	45	1	27	48	33	47	24	15
42	41	43	26	32	18	37	35	16	9
38	39	36	8	4	10	44	5	25	3
49	6	22	19	34	23	29	28	12	46
14	20	13	21	50	11	31	40	30	17
44	4	21	38	28	10	33	17	13	1
32	34	18	35	29	22	46	26	8	25
30	5	2	19	15	36	40	24	3	7
9	49	41	37	42	27	50	12	23	39
14	6	20	48	31	47	11	43	16	45

Source: Moses, L. V., and R. V. Oakford, Tables of Random Permutations. Stanford University Press, 1963. (Table VI in Procedure Manual)